I. Abstract

The sustainability of aviation directly depends on the availability of fuel. With the growing gap between production and demand, increasing prices, and concentration of known reserves in politically unstable regions, biofuels are considered a viable alternative to securing the future of aviation. Biofuels are a renewable energy source, which could be customized to different fuel needs, including jet fuel. NASA GRC has initiated a pilot program to develop in-house capabilities to study two principal sources of biofuels: sea water algae, and arid land halophytes. The present program is focused at putting together the initial infrastructure for the study, to developing a long-term program to study and optimize properties and growth parameters, and to develop collaborations with aviation companies, commercial ventures and government agencies to forward the application of biofuels to aviation needs.

II. Introduction and Background

It is becoming increasingly difficult to find oil reserves. Meanwhile, the demand for oil is increasing. What's oil used for? Its main use is to provide fuel for the vehicles that we drive on a daily basis. Unfortunately, when these fuels are burned, they emit carbon dioxide which causes global warming. Therefore, the two problems are that the desired quantity of oil is becoming more difficult to obtain, and when it is burned it brings about global warming.

Global warming has had drastic effects on the environment. Over the past ten centuries, global warming has become an issue and is being studied by many. Global warming is the gradual warming of the atmosphere. A source of tension within the industrial community is the question of who is to blame for the problem and who's responsible for its solution. Global warming is caused by the emission of heat trapping gases such as carbon dioxide, methane, nitrogen oxides and other pollutants caused by human activities. Positive feedback from the release of gases from the warming of the ocean and the melting of the permafrost will serve to increase global warming further. The issue of global warming is worsening and needs to be solved or improved to protect us and future generations.

Biodiesel is becoming a mainstream source for transportation fuel. Unlike gasoline and diesel gas, it is an improvement and will hinder global warming. The carbon dioxide produced by biodiesel is used by living plants. Thus, there is a net-zero increase in carbon dioxide in the atmosphere. However, it could probably never take the place of gasoline or diesel gas because of competition. Since it takes more energy to produce biodiesel, it would be more expensive [1]. However, when there are no more fossil fuels (oil from the ground) there will be no more competition between the two. What is true is that biodiesel will probably never be able to completely meet our energy needs. Biodiesel can be produced after a reaction known as transesterification. Transesterification is the process of converting a larger ester into a smaller ester with the same hydrocarbon chain on one side of the ester. It can be used as a step for the analysis of the hydrocarbon chain. There are two types of transesterifications: base-catalyzed and acid-catalyzed transesterifications. Base-catalyzed transesterification is mainly used for cooking oils such as canola and peanut oil (See Figure 1 below). Acid-catalyzed transesterification is mainly used for plants and algae (See Figure 2 below).

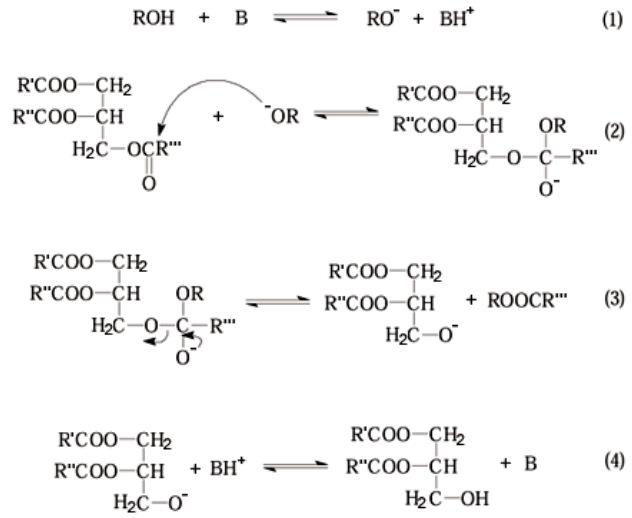

Figure 1: Mechanism of Base-Catalyzed Transesterification. Using canola oil as a starting point, methanol reacts with sodium hydroxide to form an ester and water.

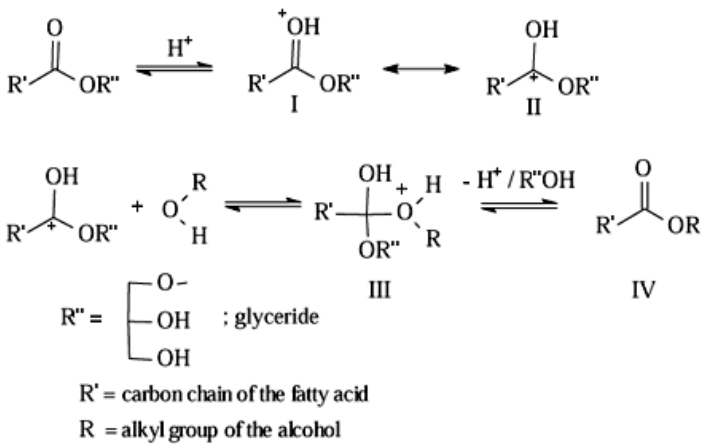

Figure 2: Mechanism of Acid-Catalyzed Transesterification. An acid is added to an ester, which in the end produces a methyl ester.

A method used to analyze methyl esters is known as Gas Chromatography/Mass Spectroscopy (GC/MS). Figure 3 shows a schematic of how the GC/MS works. The sample, which is a mixture of methyl esters, is injected into the injector and pushed through the capillary column using helium. The capillary column is lined with a particular film. Once in the capillary column, the methyl esters within the mixture are separated based on their affinities to the film [2]. The separated methyl esters then come out of the column at different times and enter the mass spectrometer. A mass spectrometer is comprised of an electron impact ionizer, an ion analyzer, and a detector. The detector then analyzes and identifies the methyl esters; then a chromatogram is constructed and displayed with application software on a computer [3].

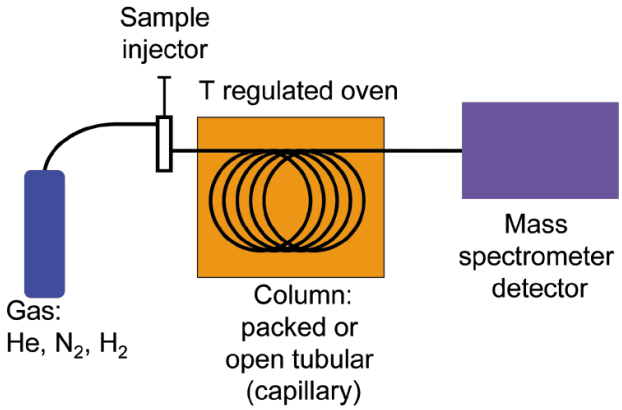

Figure 3: GC/MS Schematic

Figures 4-9 are the halophytes and algae that are germinated and harvested in the GreenLab. It takes about 30 days for salicornia to germinate, 4 months for seeds to sprout, and harvesting is done every 6 months. The world is made of 97.5% salt water, and only 1% of fresh water is accessible. Therefore, no fresh water is used in the GreenLab because it's scarce. For each system, water, soil, and sunlight are needed for growth. Fertilizers, however, are not used. Instead, fertilizers from fish are used. Also, other labs around the country inject CO_2 into their algae system, which makes it better [4]. In the GreenLab, it's totally natural; harvesting in the worst case and getting substantial growth otherwise known as climatic adaptation.

Figure 4:
Salicornia Virginica

Figure 5:
Salicornia Europea

Figure 6:
Salicornia Bigelovii

Figure 7:
Seashore Mallow

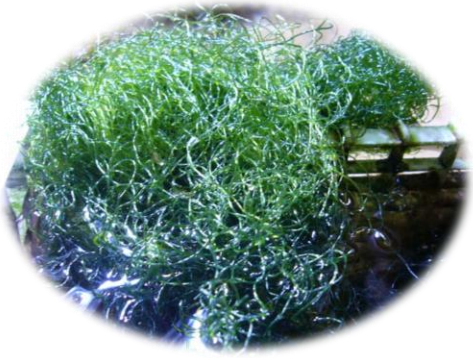

Figure 8:
Chaetomorpha

Figure 9:
Sea Purslane